

March 27, 1951

J. S. HERR

2,546,747

FEED GRINDING AND MIXING PLANT

Filed Dec. 30, 1948

3 Sheets-Sheet 1

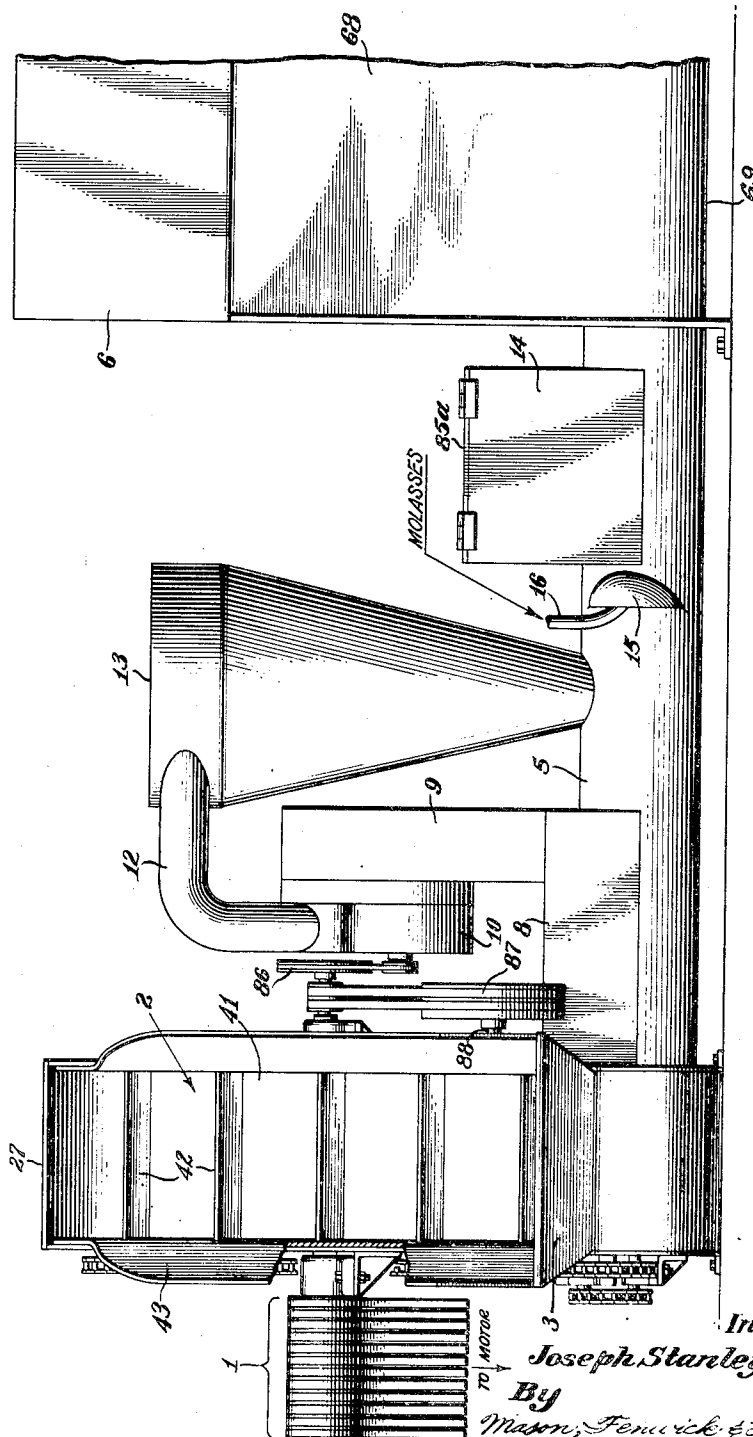


Fig. 1

Inventor,
Joseph Stanley Herr
By
Mason, Fenwick & Lawrence
Attorneys

March 27, 1951

J. S. HERR

2,546,747

FEED GRINDING AND MIXING PLANT

Filed Dec. 30, 1948

3 Sheets-Sheet 2

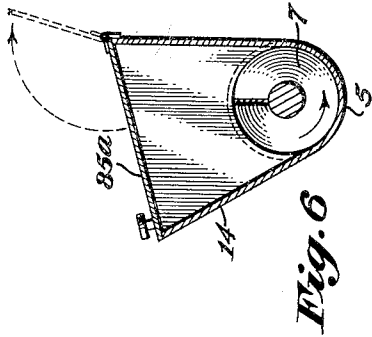


Fig. 6

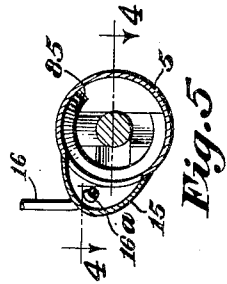


Fig. 5

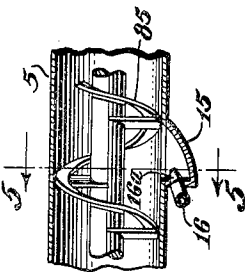


Fig. 4

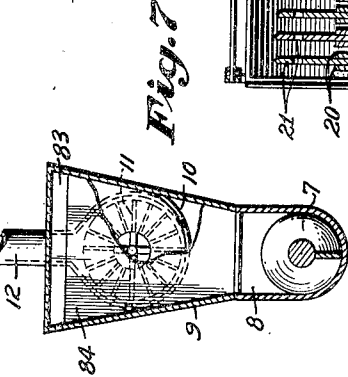


Fig. 7

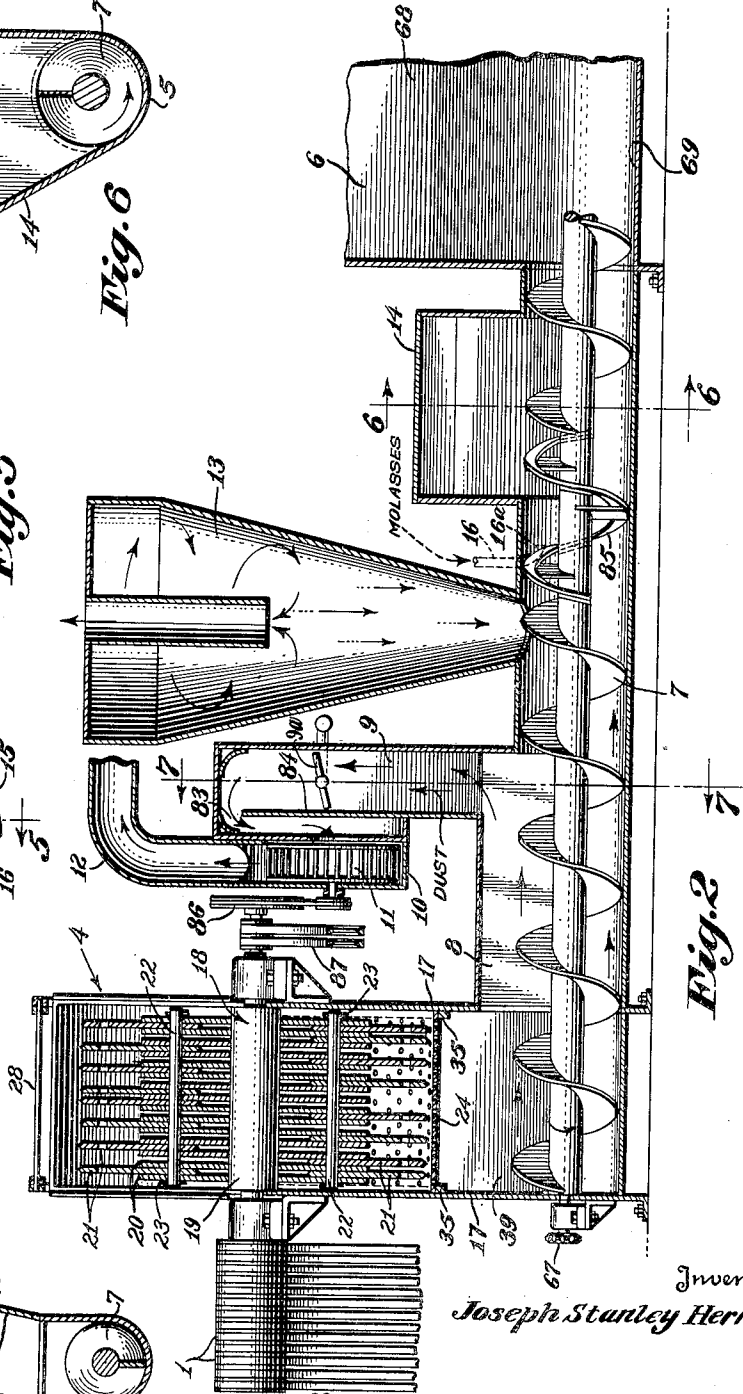


Fig. 2

Inventor
Joseph Stanley Herr

By *Mason, Fenwick & Lawrence*
Attorneys

March 27, 1951

J. S. HERR

2,546,747

FEED GRINDING AND MIXING PLANT

Filed Dec. 30, 1948

3 Sheets-Sheet 3

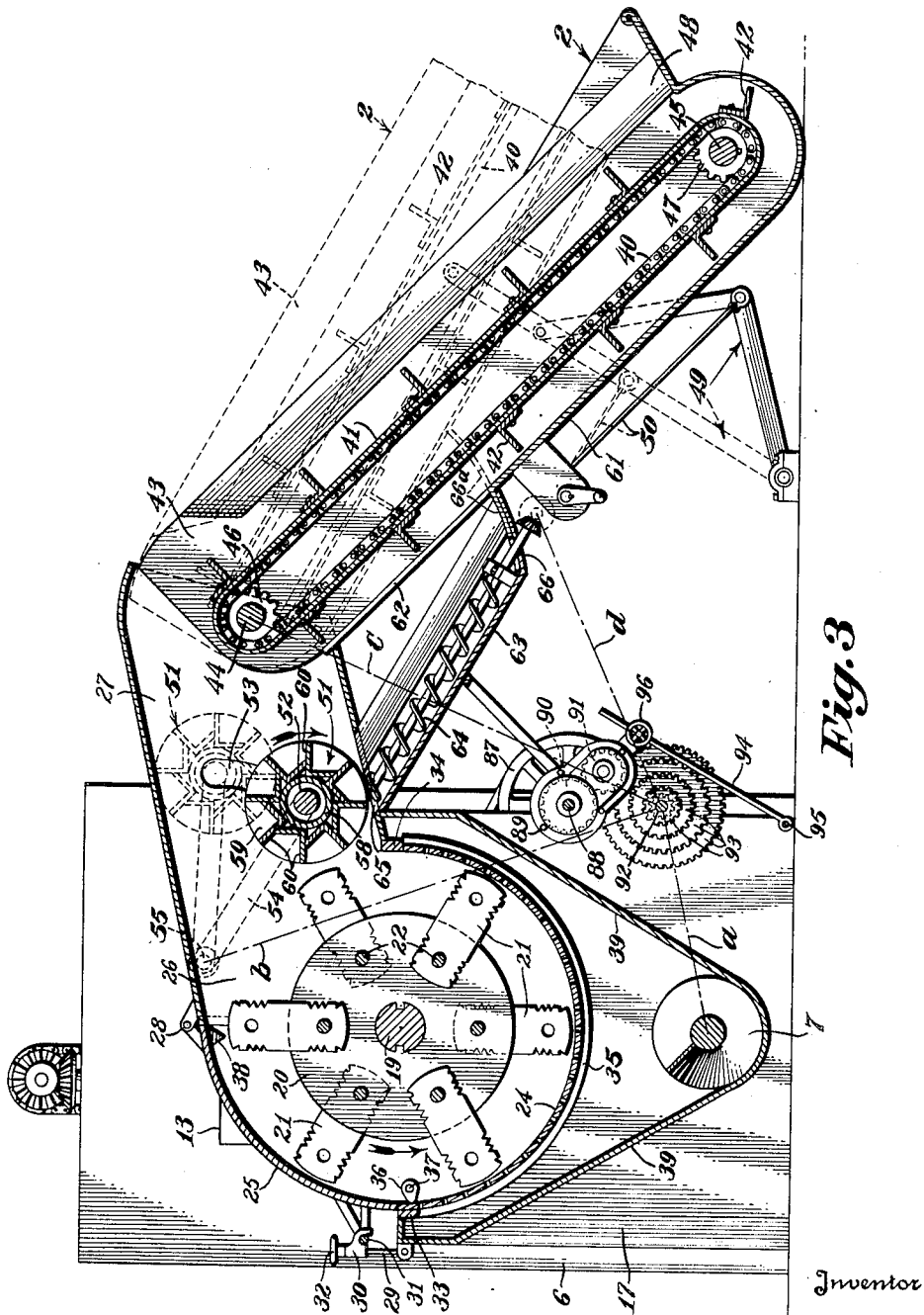


Fig. 3

Inventor

Joseph Stanley Herr

By *Mason, Fenwick & Lawrence*
Attorneys

UNITED STATES PATENT OFFICE

2,546,747

FEED GRINDING AND MIXING PLANT

Joseph Stanley Herr, Nottingham, Pa.

Application December 30, 1948, Serial No. 68,177

9 Claims. (Cl. 99—235)

1

This invention relates to apparatus for grinding and mixing stock feed.

It has for its general object to provide an integrated plant in which the entire grinding and mixing operations may be carried out, starting with raw material from the field and ending with a mixed physically dry product ready to be bagged at the discharge end of the apparatus.

Other objects of the invention will appear as the following description proceeds.

In the drawings which accompany the specification, and throughout the several figures of which the same reference characters have been employed to denote identical parts:

Figure 1 shows in side elevation the general assembly of the integrated units constituting the grinding and mixing plant, part of the mixer being broken away;

Figure 2 is a longitudinal view in vertical section;

Figure 3 is a longitudinal view in vertical section of the hammer mill and other structure appurtenant thereto;

Figure 4 is a fragmentary view, partly in section, showing the conveyor casing in the zone at which molasses is admitted;

Figure 5 is a cross-section taken along the line 5—5 of Figure 4;

Figure 6 is a cross-section taken along the line 6—6 of Figure 2;

Figure 7 is a cross-section taken along the line 7—7 of Figure 2;

Referring now in detail to the several figures, and first adverting to the general assembly shown in Figures 1 and 2, the numeral 1 represents a gang of V-belts driven by a motor, not shown, and constituting the main drive for the apparatus. 2 is the front view of a conveyor which lifts raw material from a hopper 3 and feeds it to a hammer mill 4, which is behind the conveyor in Figure 1, but seen in section in Figure 2. A casing 5 extends from the bottom of the hammer mill to the lower part of the mixer 6, containing a screw conveyor 7 which carries ground material from the hammer mill to the mixer. 8 is a dust conduit formed as an upper enlargement of the anterior part of the conveyor casing 5, leading to a gravitational separation chamber 9, which communicates with the shell 10 of a suction fan 11, communicating by way of the conduit 12 with a cyclone 13, the latter discharging clarified air from the top to atmosphere, and returning the dust to the material being handled by the conveyor 7. A hopper 14 communicates with the casing 5 between the cyclone and mixer,

2

by means of which a ready ground ingredient may be added to the feed, by-passing the hammer mill, and a blister 15 is provided on the conveyor casing anterior to the hopper 14, communicating with said casing, into which the nozzle of a molasses pipe 16 terminates. Molasses is pumped through the pipe 16 from a source, not shown.

Raw material to be ground is fed to the hammer mill. Additives are incorporated with the ground material intermediate the hammer mill and mixer, and after thorough mixing in the mixer the completed feed is discharged from the mixer directly into bags.

Referring now in detail to the hammer mill, this comprises the spaced side plates 17, constituting supports, between which and journaled therein, is the rotor 18, consisting of a driven shaft 19, on which a plurality of spaced disks 20 are fixed, having mounted therebetween circumferential series of swinging blades 21. The blades are double ended, and mounted on rods 22, which extend through the disks 20, and are removably secured by the cotterpins 23, so that when one end of the blades becomes dull, the blades can be reversed.

The rotor operates in a shell, the lower half of which is a semicylindrical perforated screen 24, the upper left quadrant of which is an arcuate hinged door 25, and the upper right quarter of which has an opening 26, the full width of the hammer mill between the side plates 17. A feed conduit 27 communicates with the opening 26, having its adjacent end congruent with said opening and connected to the structural edges which define said opening, the opposite sides of said feed conduit being planiform and parallel. The hinge of the door is indicated at 28, and a latch is provided, consisting of a swinging bolt 29, on which a keeper 30 slides, adapted to hook over a latch bar 31, carried by the door adjacent its upper edge, and tightened by means of a knobbed nut 32 threaded on the bolt 29. When the door is fully opened, it rests stably against the upper wall of the feed conduit.

Transverse frame bars 33 and 34 are secured between the side plates 17, substantially in the horizontal diametrical plane of the rotors 18, and semicylindrical tracks 35 are fixed to the side plates forming seats for the screen 24. The tracks are flush with the inner face of the bar 33, but outwardly offset with respect to the bar 34, as shown in Figure 3. Thus when the screen is in place the righthand end of the screen, Figure 3, abuts the under face of the bar 34, while the left-

hand end lies against the inner face of the bar 33.

Within the hammer mill on each side, an eccentric 35 is mounted outside the zone traversed by the blades 20, said eccentrics being each fixed to a shaft 37 journaled in the respective side plates 17 and outwardly bent to provide operating handles, Figure 4. The eccentrics can be turned to bear against the adjacent end of the screen and hold it pressed against the bar 33, or they may be oppositely turned to release position to permit removal of the screen.

The door 25 is formed with a volute curvature so that while it merges at its free edge with the cylindrical curvature of the lower half of the shell, it progressively curves outwardly away from the cylinder of revolution described by the blades 21, making room for the breaker 38 which is secured to the inner face of the door adjacent its hinged edge. The breaker 38 extends the width of the hammer mill and preferably has a knife edge slightly spaced away from the path of the ends of the blades.

The screen 24 may be replaced by one of different mesh size, when desired. To remove the screen the door 25 is opened wide and let rest upon the said conduit 27. This gets the breaker out of the way. Then the screen is rotated about its axis in a counterclockwise direction, as viewed in Figure 3, until its leading end has moved far enough into the feed conduit 27 to let its trailing end clear the end of the track 35, whereupon it may be lifted out.

Beneath the screen 24 is a closed collecting chamber for the ground product of the hammer mill, defined between the side plates 17, and a downwardly convergent bottom plate 39, into which the end portion of the screw conveyor 7 extends.

Raw material is delivered to the feed conduit 27 by the conveyor 2, which comprises fundamentally a pair of spaced endless chains 40, bridged by an endless belt 41, and having transverse cleats or vanes 42 secured at intervals to said belt, projecting perpendicularly therefrom. The chains and belt are connected so as to move as a unit. An open topped housing 43 encloses the conveyor, having parallel sides in which the shafts 44 and 45 are journaled respectively at the top and bottom, said shafts carrying sprockets 46 and 47 with which the chains mesh, one being a driven sprocket. The sides of the housing 43 closely fit the conveyor to prevent material spilling laterally into the lower part of the housing. The open top of the housing is bordered by flared sides which form a hopper 48 at the lower end for receiving the raw material. The conveyor unit consisting of the conveyor and housing is hinged to the adjacent end of the feed conduit 27 on the axis of the shaft 44, so that the conveyor may be swung to elevate or depress its lower end, when desired. The toggle linkage, designated as a whole by the numeral 49, and pulled straight by a hand crank operated cable 50, accomplishes this purpose. The upper end of the housing 43 opens into the conduit 27.

Within the conduit 27 is a driven feeding roll 51. This extends the full width of said conduit and is designed to rest gravitationally upon the material and to propel it forwardly into the hammer mill. Since the material is not delivered by the conveyor 2 at a uniform rate, it will not be of uniform thickness when it comes to the roll, so the latter must have freedom to rise and fall as it entrains beneath the different thicknesses of the raw material. Therefore, the shaft 52 of the roll

passes through upwardly directed congruent arcuate slots 53 at the sides of the conduit 27. Said shaft is journaled in arms 54 on the outside of conduit 27, as indicated in broken lines in Figure 3, the arms being pivotally mounted on a shaft 55 journaled in the sides of said conduit. Chain connected sprockets, not shown at one side of said conduit, respectively on the shafts 52 and 55, drive the feeding roll which rotates in a clockwise direction, as indicated by the arrow in Figure 3.

The feeding roll, as shown, is made up of a central drum 58, having end heads 59 fixed thereto, said heads being keyed to the shaft 52. Angle bars 60 are secured against the drum and to the end heads, with a corresponding flange of each extending radially. Material receiving pockets are thus formed between successive flanges.

In operation, raw material is dumped into the hopper 48, carried to the top by the conveyor, dropped into the conduit 28 in front of the roll 51, beneath which it is entrained and fed over the lip of the hammer mill constituted by the bar 34. The blades of the hammer mill throw it against the breaker 38, where it is preliminarily broken up between the breaker and the passing blades. The subsequent grinding action is that normal to conventional hammer mills, and the ground material passes through the screen 24 into the collecting chamber, where it falls into the screw conveyor 7. Some of the raw material deposited in the conduit 27 will inevitably get into the part of the housing 43 traversed by the lower flight of the conveyor. To prevent this from going down into the lower end of the housing where it might pack and jam the conveyor, the floor 61 of the housing is provided with an opening 62 near the top, the full width of the housing, underlain by a downwardly convergent closed box 63, the bottom of which contains the upwardly directed screw conveyor 64 which discharges through an opening 65 into the conduit 27 in the region of the feeding roll 51. Any material that enters the housing in the path of the lower flight of the conveyor falls through the opening 62 into the box 63 and is returned by the conveyor 64 to the conduit 27.

The lower end wall of the box 63 is sectional, curved with a radius centered at the axis of the shaft 44 about which the conveyor unit swings. The section 66 is a fixed part of the box. The section 66a which laps the section 66 is carried by the housing 43 and moves therewith. The section 66a is long enough to keep contact with the section 66 throughout the range of swing of the conveyor unit.

The screw conveyor 7 is driven from the sprocket 67 at the left side of the hammer mill, and carries the ground material to the mixer 6 into which it enters and functions as a mixing element.

Since grinding the raw material in the hammer mill is a dusty operation, it is conventional to make the hammer mill air swept. The present invention provides an improved dust collecting system which returns the dust to the body of ground material prior to its entering into the mixer.

Referring to Figure 2, it is seen that the dust conduit 8 provides an unobstructed space above the path of rotation of the screw conveyor 7, connecting the collecting chamber of the hammer mill with the gravitational separation chamber 9. The separation chamber extends in an upward direction and is of greater cross-section

5

tional area than the conduit 8, so that the velocity of flow is reduced within said chamber, permitting the larger dust particles to gravitate into the conveyor casing 5. In order to take full advantage of the gravitational separation within the chamber 9, the discharge therefrom to the fan 11 is at the top of said chamber through an opening 83 above the partition 84, which forms the back wall of said chamber, requiring the maximum vertical travel of the dust laden air through said chamber. The air discharged from the separation chamber 9 is blown from the fan 11 into the cyclone 13, from which the clarified air issues to atmosphere from the top of the cyclone, the dust discharging from the lower end of the cyclone upon the conveyor 7. A valve 9a may be provided in the passage between the conduit 8 and fan 11 for regulating the velocity of flow of dust laden air to the fan.

Between the dust conduit 8 and the discharge end of the cyclone, the casing 5 closely fits the conveyor screw, so that the ground material filling this part of the conveyor acts as a seal to prevent the fan from sucking dust back from the cyclone.

Between the cyclone and mixer provision is made for introducing a liquid ingredient, such as molasses, into the ground mass, including the pipe 16, which comes from a reservoir not shown, of the liquid material. If the pipe opened flush in the wall of the conveyor casing 5, the dry material would be forced into the open end of said pipe, where a sticky conduit naturally exists, resulting in stopping up of the pipe. A blister 15 is provided on the casing 5, enclosing a space offset from the path of rotation of the conveyor, into which space the nozzle end 16a of the pipe 16 projects and terminates, being directed tangentially to the conveyor and in its direction of propulsion. The flight of the conveyor screw in the region of the molasses pipe nozzle, designated by the numeral 85, is of the same ribbon type described in connection with conveyors 70 and 78 of the mixer, so that the ground material and molasses undergo a preliminary mixing in this zone.

The hopper 14, which is for the introduction of an ingredient that does not require grinding, is normally closed by the door 25a, shown in Figure 6.

The driving trains for the several instrumentalities which constitute the grinding and mixing plant, as described, are conventional and may be briefly described as follows.

The hammer mill works at a constant speed and is driven from the belts 1 through a pulley on the shaft 19 of the rotor of the hammer mill. From the same shaft the fan 11 is driven at a somewhat reduced but constant speed through the pulley and belt connection 86, Figure 2. From this same shaft there is a pulley and belt connection 87 to a lay shaft 88, Figures 1 and 2. On the lay shaft a gear box 89 is axially slidable, and swingable, having two meshing gears 90 and 91 journaled therein, the gear 90 being freely splined on the lay shaft so as to rotate therewith, but to slide thereupon. A variable speed final drive shaft 92 is in operative proximity to the gear box, carrying a plurality of concentric different sized gears 93, with any one of which the gear 91 may be meshed by appropriately sliding and swinging the gear box 89. The rod 94 is part of the conventional structure, being slidable axially upon a bar 95, having its upper end passing slidably through an aperture in the gear

6

casing, and being clamped by the clamp screw 95, said rod functioning to hold the gear 91 in mesh with the selected gear of the final drive shaft 92. Said final drive shaft has flexible driving connections with the shaft of the screw conveyor 7, the shaft 55 which drives the feed roll 51, the shaft 44 of the conveyor 2, and the shaft of the conveyor 64, said connections being represented diagrammatically in Figure 3 by the lines a, b, c, and d.

While I have in the above description disclosed what I believe to be a preferred and practical embodiment of the invention, it will be understood by those skilled in the art that the specific details of construction and the arrangement of parts, as shown, are by way of example and not to be construed as limiting the scope of the invention.

What I claim as my invention is:

1. Feed grinding and mixing plant including in combination an air swept grinding mill having a collecting chamber, a mixer, a conveyor from said collecting chamber to mixer including a screw and casing therefor, means for drawing air through said grinding mill under vacuum and conserving the dust therefrom comprising a fan having its induction side communicating with said collecting chamber through the anterior portion of said casing, and having its eduction end communicating with said casing at a posterior point, means forming a gravitational separation chamber between said induction side and said casing, in which the velocity of flow toward said fan is reduced, and a cyclone between said eduction end and said casing having its dust discharge end opening into said casing.

2. Feed grinding and mixing plant as claimed in claim 1, said conveyor casing having a cross-sectional area exceeding the cross-sectional area of the cylinder of revolution of said screw, between said collecting chamber and said gravitational separation chamber.

3. Feed grinding and mixing plant as claimed in claim 1, the wall of said conveyor casing between the point of dust discharge from said cyclone and said mixer having an enlargement defining a recess outside the cylinder of revolution of said screw, and a pipe for introducing liquid projecting into and terminating in said recess.

4. Feed grinding and mixing plant including in combination, an air swept grinding mill having a collecting chamber, a mixer, and a conveyor from said collecting chamber to said mixer including a screw and casing therefor, said screw extending within said mixer and functioning as a mixing instrumentality therein, means for discharging liquid into said casing adjacent said mixer, the vane of the conveyor screw from said collecting chamber to a point adjacent said molasses discharge being unbroken from its root line to periphery, and said vane in a zone in which said molasses discharges comprising a peripheral ribbon spaced from the shaft of said screw, whereby said molasses is mixed with the ground material in said conveyor.

5. Feed grinding and mixing plant including in combination, an air swept grinding mill having a collecting chamber, a mixer, a conveyor from said collecting chamber to mixer including a screw and a casing therefor, means for drawing air through said grinding mill under vacuum and conserving the dust therefrom comprising a fan having its induction side communicating with said collecting chamber through the anterior portion of said conveyor casing and having its

7

eduction end communicating with said casing at a posterior point, means forming a gravitational separation chamber between said induction side and said casing in which the velocity of flow toward said fan is reduced, a cyclone between said eduction end and said casing having its dust discharge end opening into said casing, the wall of said casing between the point of said dust discharge from said cyclone and said mixer having an enlargement defining a recess outside the cylinder of revolution of the screw of said conveyor, a pipe for introducing liquid projecting into and terminating in said recess, a hopper for already ground material communicating with said casing between said enlargement and mixer, the vane of the conveyor screw from said collecting chamber to a point adjacent said molasses discharge being unbroken from its root line to periphery, and said vane in a zone which includes the point at which said molasses discharges, and at least part of said hopper, comprising a peripheral ribbon spaced from the shaft of said casing, whereby said molasses is mixed with the ground material in said conveyor.

6. Feed grinding and mixing plant including in combination an air swept grinding mill having a collecting chamber, a mixer, a conveyor from said collecting chamber to mixer including a screw and casing therefor, said casing being a close fit about said screw in an intermediate zone whereby to substantially block the free passage of air through said casing in said zone, said casing anterior to the portion thus blocked having a cross-sectional area greater than the cylinder of revolution of said screw whereby to provide an air passage from said collecting chamber, a fan, a dust separator, the induction side of said fan being connected to said air passage and the eduction side to said separator, an air discharge from said separator to atmosphere and a dust discharge from said separator to said casing in said blocked portion.

7. Feed grinding and mixing plant including in combination an air swept grinding mill having a collecting chamber, a mixer, a conveyor from said collecting chamber to said mixer including a screw and a casing therefor, said screw extending into said mixer and constituting a mixing element of said mixer, said casing being a close fit about said screw in an intermediate zone whereby to substantially block the free passage of air through said casing in said zone, said casing anterior to the portion thus blocked having a cross-sectional area greater than the cylinder of revolution of said screw whereby to provide an air passage from said collecting chamber, a fan, a dust separator, the induction side of said fan being connected to said air passage and the eduction side to said separator, an air discharge from said separator to atmosphere and a dust

8

discharge from said separator to said casing in said blocked portion.

8. Feed grinding and mixing plant including in combination an air swept grinding mill having a collecting chamber, a mixer, a conveyor from said collecting chamber to mixer including a screw and casing therefor, means for drawing air through said grinding mill under vacuum and conserving the dust therefrom comprising an up-standing conduit communicating with the anterior portion of said casing forming a settling chamber, a fan having its inlet below the top of said settling chamber, a conduit from the top of said settling chamber to the inlet of said fan providing a direction change for the air column passing from said settling chamber to fan, a dust separator, a conduit from the outlet of said fan to said dust separator, the latter having an air discharge to atmosphere and a dust discharge communicating with said conveyor casing at a point posterior to the point at which said settling chamber communicates with said conduit.

9. Feed grinding and mixing plant as claimed in claim 8, said conveyor casing being a close fit about said screw between the points of communication with said casing of said settling chamber and said dust discharge, to prevent back draft of dust from said dust discharge.

JOSEPH STANLEY HERR.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
44,989	Whelpley	Nov. 8, 1864
103,804	Whelpley et al.	May 31, 1870
490,611	Miller	Jan. 24, 1893
875,143	Boileau	Dec. 31, 1907
1,036,327	Pickett	Aug. 20, 1912
1,129,866	Hamel	Mar. 2, 1915
1,454,492	Stroud	May 8, 1923
1,575,458	Stonesifer	Mar. 2, 1926
1,585,931	Mabee	May 25, 1926
1,647,555	Wells	Nov. 1, 1927
1,659,499	Sedberry	Feb. 14, 1928
1,788,345	Skirvin	Jan. 6, 1931
1,886,103	Jali	Nov. 1, 1932
1,996,177	Stevenson	Apr. 2, 1935
2,047,599	Snyder	July 14, 1936
2,177,910	Smit	Oct. 31, 1939
2,230,146	Myers	Jan. 28, 1941
2,286,277	Huddle	June 16, 1942
2,351,070	Schmidt	June 13, 1944

FOREIGN PATENTS

Number	Country	Date
583,654	Great Britain	Dec. 23, 1946